2017

Skinface

Islam Shehab

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Acknowledgements

بِسْمِ اللهِ الرَّحْمٰنِ الرَّحِيْمِ

BISMILLĀHIR-RAḤMĀNIR-RAḤĪM

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1. Abstract

Throughout history, skin manipulation was primarily practiced for cultural, tribal, or religious purposes. In the contemporary landscape, skin manipulation has been objectified and commercialized. This is exemplified through bio-upholstery, foreign materials under our skin and changing the skin structure.

This thesis investigates skin manipulation, with the intent to focus experimentation on the skin's lines of cleavage, a topographical map drawn on our skin and used to define the direction where skin has the most and least flexibility. The aim is to connect and explore materials that can be used as a second skin, while at the same time examining and utilizing the lines of cleavage found within the structure of skin.

The focus of this thesis is to examine the potential of different materials, as a second skin that enhances our skin and its properties of protection. Through experimentation I aim to explore an alternate second skin's function, through a series of experiments that address flexibility, protection, and memory.

Fig.1

2. Introduction

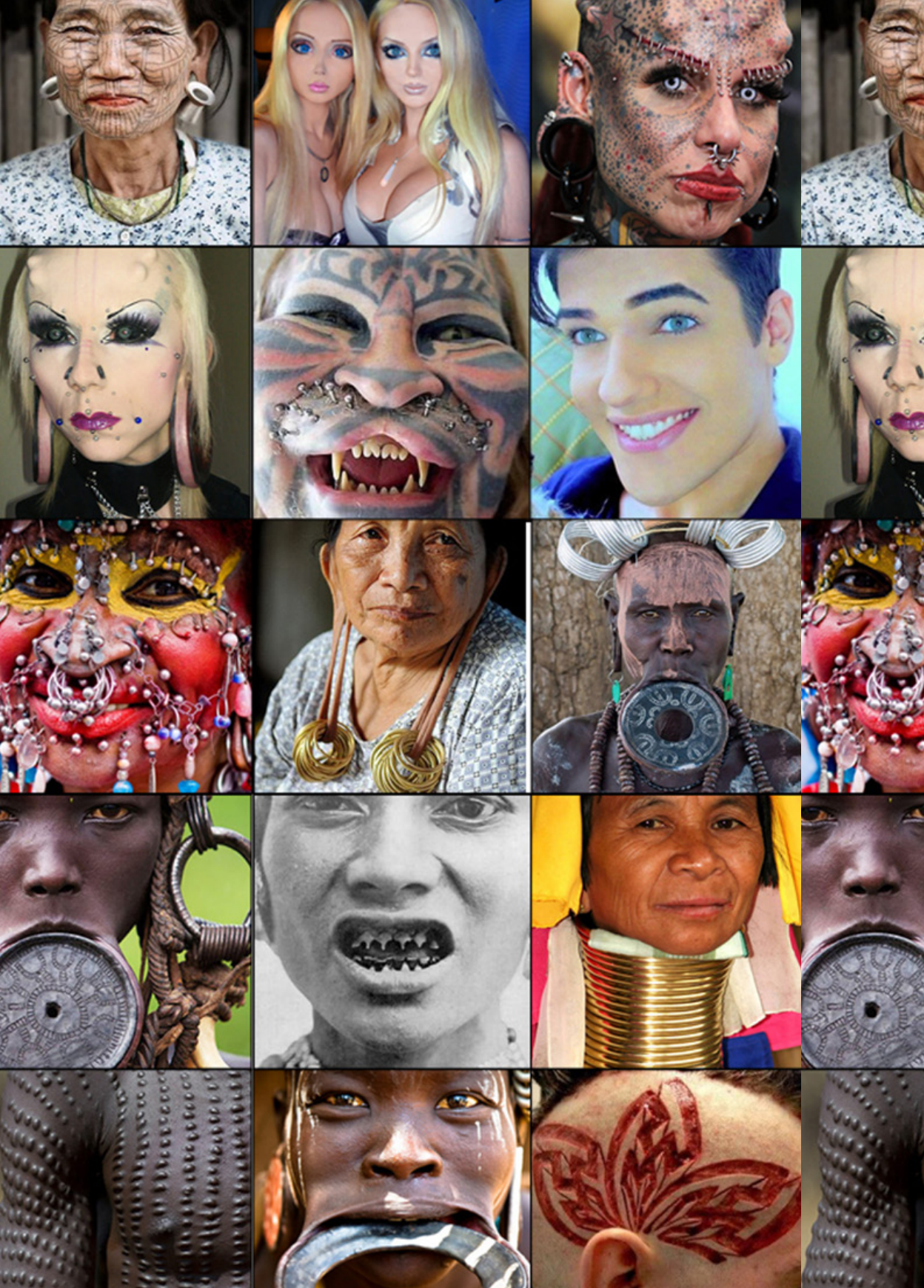
Body augmentation is a deliberate act, whether a permanent or temporary bodily intervention, that changes or augments otherwise normal ranges of human function or appearance. Many forms of body augmentation, such as tattoos, piercings and cosmetic surgeries, have become so commonplace and socially accepted that they don't pose difficult ethical questions. However, increasingly advanced manipulation through advanced forms of sensory and genetic modification pose weighty ethical questions.

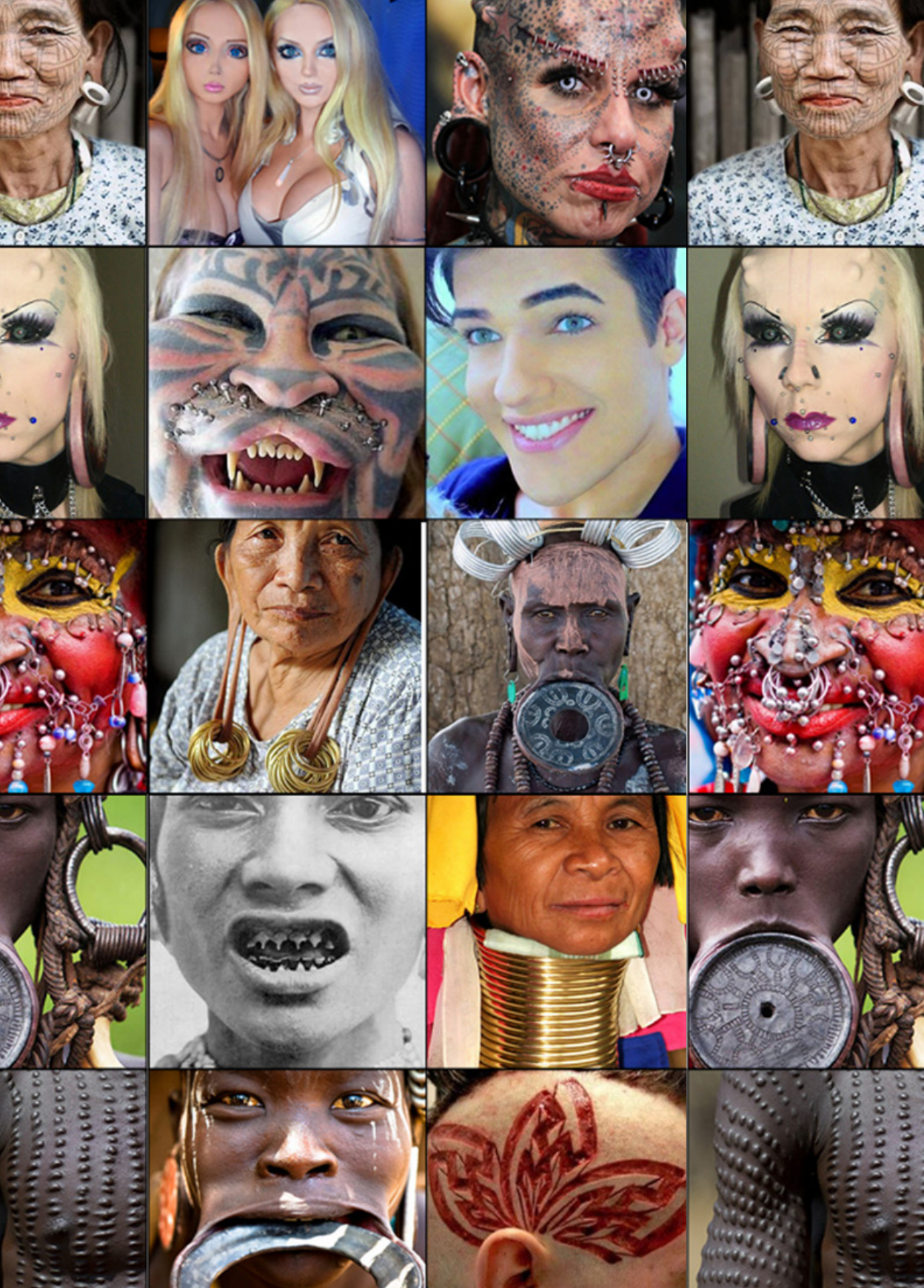
This thesis explores the use of various materials used to wrap skin in order to study the inherent properties of skin while focusing on its function and relationship to the lines of cleavage. This is done in order to explore and assess the alternate functions that these materials can offer in material flexibility, memory, and protection of skin. The objective of this thesis is to examine the use of materials as a second skin through a series of experiments using kerf cutting and weaving techniques to imitate the different functions of human skin.

The human body's skin is our largest organ. One of the main functions to our skin is to protect our body from losing its temperature, and protect the inner organs from being exposed.

Tailoring materials to mimic the body invokes the concept of a second skin. The mimicking process requires looking at the body as a site upon which material, measurements, tools, and construction techniques act as starting points for a second skin to reflect the body. The concept of tailoring implies close similarities between the body, materials, and the notion of a "second skin."

Fig.2





3. BACKGROUND

3.1 Body Modification

Body modification can have strange and scary implications for people who have no personal interest or experience in the subject; however, modifying the body is part of human culture that transcends class, race, and human history.

In the simplest terms, body modification means to deliberately alter one's physical appearance, though people usually assume the phrase applies only to such practices as tattooing and piercing or the more symbolic branding and scarification. However, all one has to do is look at society's present definition of aesthetic to discover that almost all of us engage in some form of body modifying or adornment. For instance, among women, the practice of ear piercing is so common that it barely registers as a modification, and one of the most involved, long-term, and committed types of body modification, body building, is not considered to be exactly what the name implies. Likewise, surgical body modification has become extremely common, especially in the form of cosmetic surgery. These procedures are rarely considered shocking or odd unless the procedure goes wrong or the resulting aesthetic is outside of the socially accepted standard of beauty.

Fig.3

3.2 History of Body Augmentation

Human augmentation goes back centuries, even millennia. It has been a cultural obsession throughout history to achieve alternate interactions for the human body according to the title and the position of the person, to transcend the natural human body and become something more divine, perhaps even god-like.

The earliest prosthesis, known as the Cairo Toe, seemed to have no intention of bettering nature but rather it imitated the exact shape and form of the original toe. This toe was created without any advanced technology. It is fascinating how they managed to create the earliest prosthetic portraying the human toe, using only wood as a material.[1]

The Cairo Toe left me wondering how it functioned without any joints or knuckles. In contrast, the visibility of robotic parts that replaced human limbs became exaggerated when advancements in technology and biology intertwined. “My new leg added to me, it didn’t take away,”[2] said Victoria Modesta, a bionic artist and a creative director. She exemplifies the future of human innovation and her work explores modern identity through technology and science.

Fig.4

Fig.5

3.3 Identity Modification

Scarification and branding involve applying heated material, usually metal, to the skin, in order to create an elevated scar, permanently marking the skin. It is an ancient technique practiced by a few tribal cultures, which brand, scar or cut during initiation rituals to mark young males as fully grown adult members of their tribes as a means to show loyalty.

These practices function more as systems of affiliation or association especially amongst tribal groups, in and around areas of Africa and Asia.[3] People modify their bodies to commemorate events such as: surviving a trauma, coming of age, winning a war, or losing a loved one. It is fascinating how those skin manipulations happen due to an environment, event or circumstance. One such example is the Vampire Lady, a Mexican mother of four who was domestically abused. She chose to change her physical identity into a novel version of herself by altering her skin through excessive tattooing and piercing.[4]

The connection between the Vampire Lady and the African tribes are the circumstances that led those people to modify and alter their skin. She went through the trauma of domestic abuse, which led to her decision to engage in body modification and develop a new identity so she can prove to herself and the society that she changed. Tribal modifications are due to similar reasons such as proving their manhood and loyalty to their tribes.

4. Anatomy of the Human Skin

The skin is the largest organ of the human body. In the adult, it has an approximate surface of 1.8m2 and a weight of 10kg. Human skin consists of three main components: the *epidermis* which is the outer protective layer, the *corium* or *dermis* that provides mechanical stability and contains important functional structures such as blood and lymph vessels, nerves and appendages, and the *subcutis* which is mainly composed of adipose tissue and provides the connection between the dermis and deeper structures of the body such as the muscles.[5]

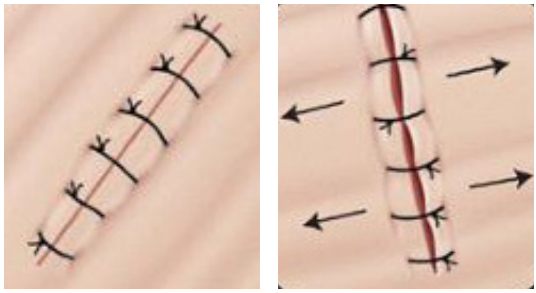


Fig. 6

4.1 Skin's Lines of Cleavage

Lines of cleavage, also called Langer's lines, can be seen as a topographical map drawn on our skin used to define the direction of which skin has the least flexibility. These lines correspond to the alignment of collagen fibers within the internal layer of the skin.[6] Knowing the direction of the lines within a specific area of the skin is important for surgical operations, particularly cosmetic surgery. Usually, a surgical cut is carried out in the direction of the lines of cleavage, and incisions made parallel to the lines generally heal better and produce less scarring. Sometimes the exact direction of these lines is unknown because in some regions of the body there are differences amongst different individuals. Directional changes of Langer's lines have been known to occur within the course of a person's lifetime.[7]

This map of lines illustrates the various lines of cleavage on the body and can correspond to varying degrees of thickness (between 0.1 and 1 mm) depending on the thickness of the *stratum corneum* which is largest at the hands and feet. The lines of cleavage are denser in these two areas, which address the most flexible areas, and they represent our textile senses since they are the most areas in contact with our environment.[8]

Fig. 7

4.2 Skin Functions

Main Physiological Functions of the Skin

As our skin is the largest organ in the human body, one of its main functions is as a barrier to the body's environment - protection from physical, chemical and biological influences, as well as protection for the body's interior, such as from the loss of water and other bodily substances. Thermoregulation is the skin's ability to preserve the body's temperature and prevent it from getting affected by the outside temperature.[9]

The outer 5 – 8 mm layer of the skin is called the *Dermis*. Within the dermis are the blood capillaries, nerve endings, sweat glands, hair follicles and this is where the map for the lines of cleavage. Below the dermis is the *Subcutis*, which is structured by fibers that attach it to the underlying musculature. On the surface of the dermis is the *Epidermis*, which we all see as the surface of the skin. Where the epidermis and the dermis meet is a fibrous area called the *Junctional Zone*.[10]

Barrier Function of the Skin

An important function of the skin is to act as a barrier between the interior of the body and the environment. The barrier sustains the integrity of the organism by protecting it from outside physical, chemical and microbiological damage as well as from the loss of essential body substance.

Skin Intolerance Reactions

As a barrier organ, the skin is subject to environmental damage that may lead to intolerance reactions like those that appear when the skin comes in contact with an irritant or an allergen. Symptoms can include: a rash, blisters, itching, and burning.

Two main types of reactions can arise: nonspecific irritant reactions following a chemical or physical trauma, and allergic reactions occurring only in individuals sensitized to a specific substance. In sensitized individuals, allergic reactions usually show a lower elicitation threshold than irritant reactions. Both reactions maybe caused by clothing and are thus reactions to the textile.[11] Different skin reactions may show up with age or with physical change to the human skin such as wrinkles and stretch marks. When these reactions happen in specific areas on the skin, they are a physical representation to the skin lines of cleavage. These reactions show that the skin has been through physical change and those are the reactions to that change.

4.3 SkinReactions

Skin is the largest organ and protects the rest of the organs. However, skin fails in certain instances, similar to other organs, and some of these failures are to alert the human body regarding health or mental conditions such as one's diet routine, stress level, and emotional condition.[12]

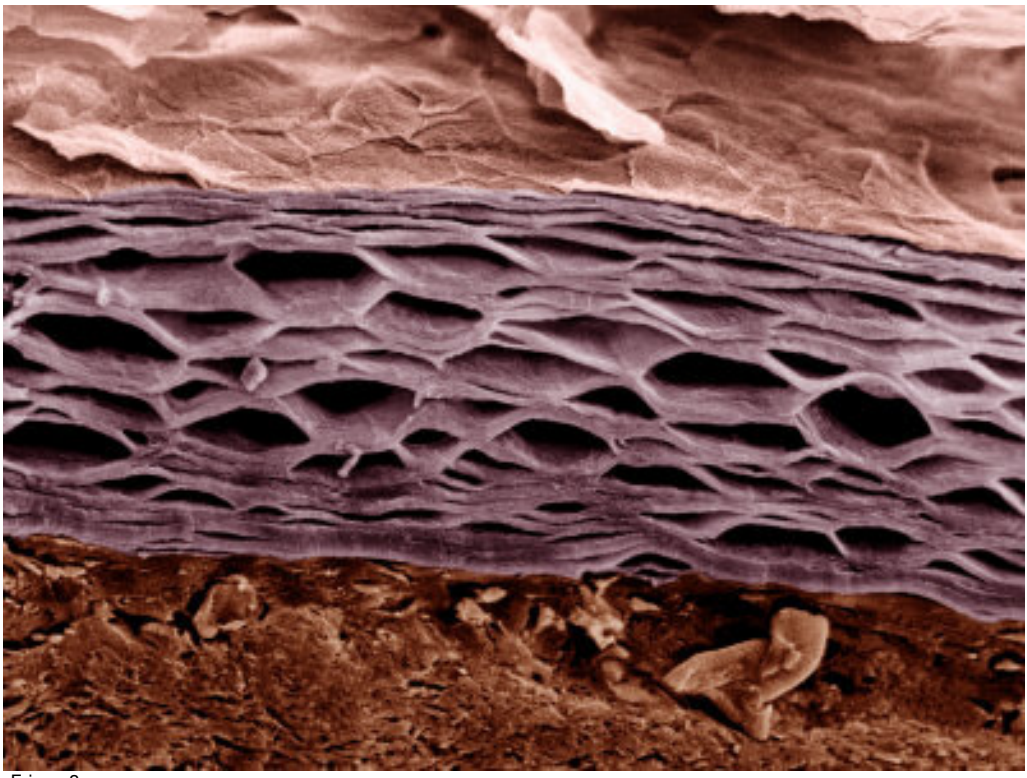


Fig.8

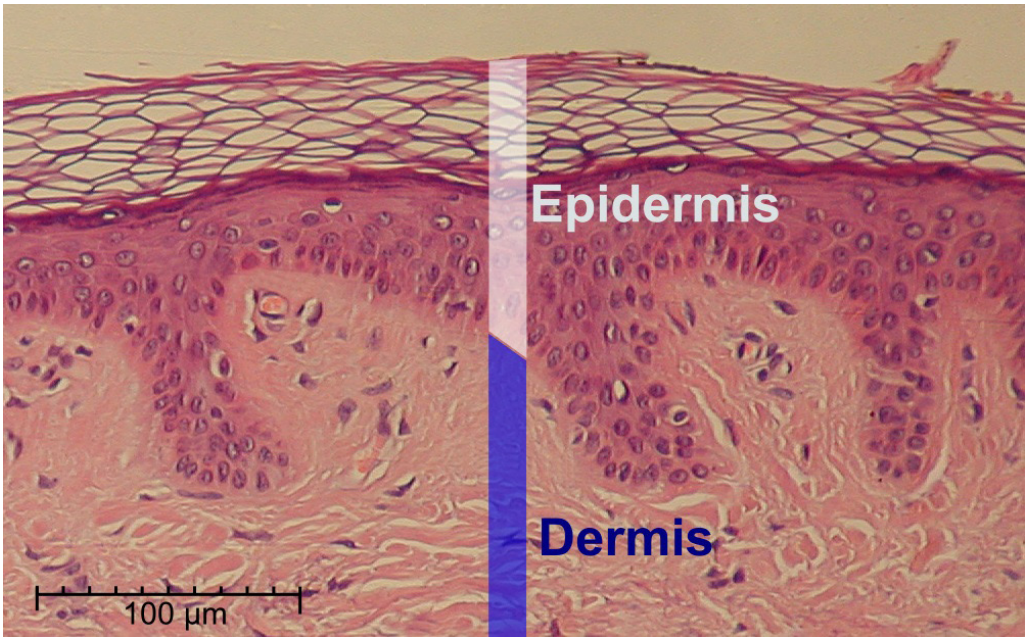


Fig.9

Stretch Marks

Stretch marks occur when the skin is pulled by rapid growth or stretching. Although the skin is fairly elastic, when it's overstretched, the normal production of collagen (the major protein that makes up the connective tissue in human skin) is disrupted. As a result, scars called stretch marks may form. [13]

Fig.10

Warts

A wart is a skin growth caused by certain types of the human papillomavirus (HPV). HPV infects the top layer of skin, usually entering the body through an area of broken skin. The virus causes the top layer of skin to grow rapidly, forming a wart. Most warts go away on their own within months or years. [14]

Fig.11

Pimple and Acne

Pores become clogged if there is too much sebum production and too many dead skin cells. Bacteria gets trapped inside the pores and multiplies. This causes swelling and redness — the start of acne. [15]

Fig.12

Wrinkles

Wrinkle development comes with age and a shortage of collagen in the skin. Collagen is the material that makes skin flexible which has been shown to deteriorate as one ages. Due to the shortage of collagen, the lines of cleavage become highlighted.[16]

Fig.13

Burns

Second-degree burns affect the outer layer of skin. They cause pain, redness, swelling, and blistering. Third-degree burns (full thickness burns) affect deeper tissues. They result in white or blackened, charred skin that may be numb. [17]

Fig.14

Scars

Skin wounds can be caused by many things, such as accidental injuries or surgical procedures. The permanence of the scar depends on the direction of the scar in relation to the lines of cleavage. If the wound is parallel to the lines it will heal faster and won't scar, however, if it is opposite to the lines direction, it will scar and heal slower.[18]

Fig.15

4.4 Importance of Lines of Cleavage

The focus of this thesis is to examine the potential for utilizing different materials as a second skin. The aim is to use materials that improve the function of the lines of cleavage by acting as a second skin in accordance with underlying structures of skin in order to address flexibility, protection, and memory.

Anatomical importance: The existenc and importance of the parallel arrangement of fibers which constitutes sheets or strands running in the lines of increased tension, form the lines of cleavage. The interlacing arrangement of the minority of the fibers binds the parallel fibers into a coherent whole. This parallelism of the skin fibers remains hidden when the skin is sectioned at random and can only be demonstrated by orientating the skin sections around a narrow slit puncture.[19]

Surgical importance: Incisions at right angles to these lines leave widely stretched unsightly scars. The newly formed scar tissue in such incisions stretches because it is subject to the full force of the lines of increased tension, which now run at right angles to the line of incision. In planning an incision much emphasis must be correctly laid on its direction in relation to the access it provides, and the trauma it imposes on underlying structures. In closing an incision surgical fashion has at different times dictated a variety of methods of skin approximation in an endeavour to obtain a fine linear scar. The one decisive factor in the production of a fine linear scar is not so much any particular method of wound suture, but rather the relation that the direction of the incision bears to the cleavage lines.[20]

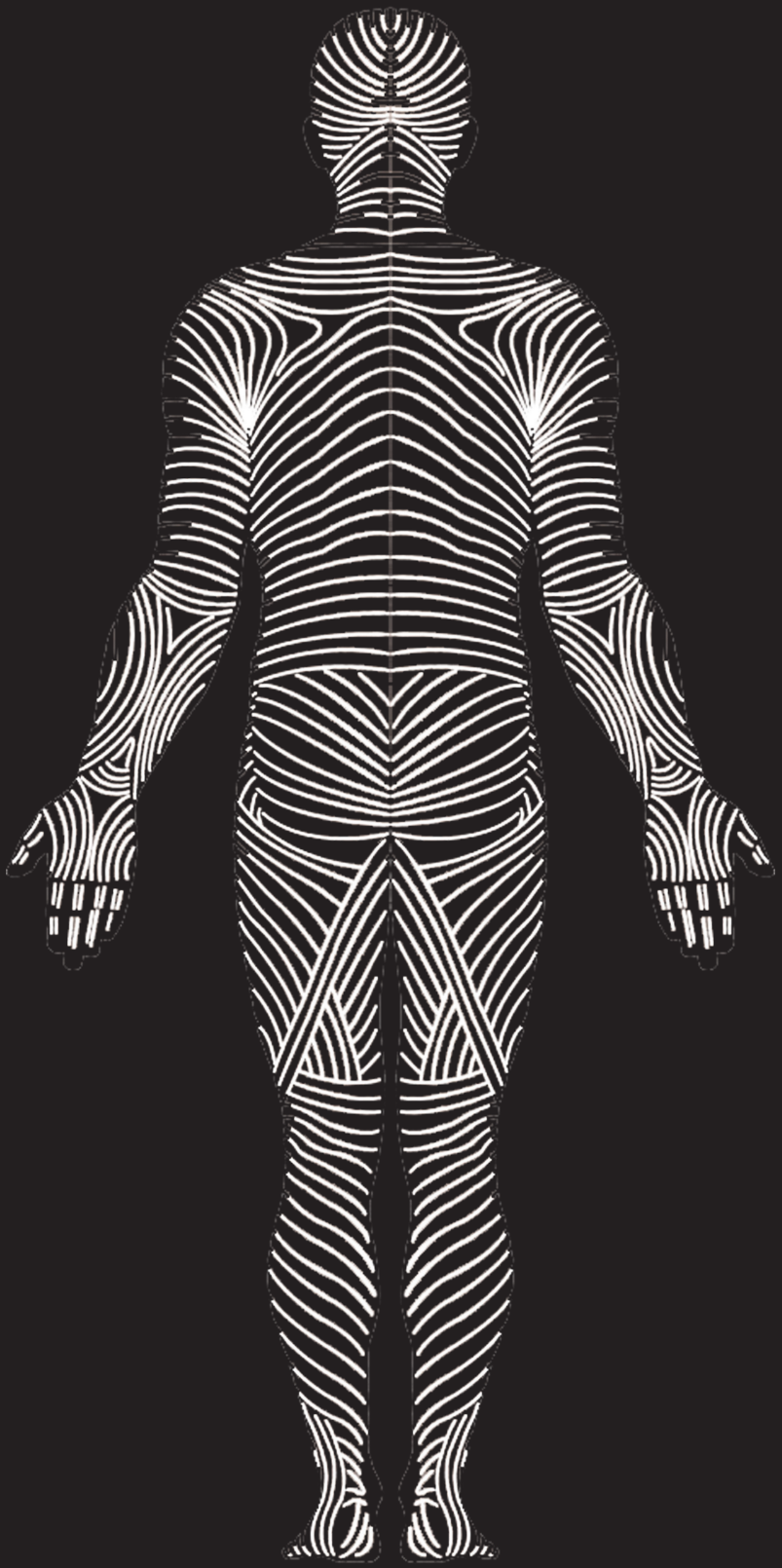


Fig.16

5. Tailoring Second Skin

Clothing and textiles are the major skin protectors which are considered as a second and parallel skin. The following study will explain the relevance between the textile grain structure, which covers our bodies, and the human skin's lines of cleavage.

5.1 **Skins that Wrap Us**

Tailoring cloth to mimic the body invokes the concept of a second skin. The mimicking process requires looking at the body as a site upon which material, measurements, tools and construction techniques act as starting points for a garment to reflect the body. While the concept of the second skin implies close similarities to the body, the fit of clothing will never be an exact replica for our skin, thereby revealing a degree of distance between the body and clothing.

The physical and conceptual gap between the skin and clothing is about how to shape material into form. As a soft, pliable layer, clothing relies upon seams and the cut of cloth to gain structure, whereas our skin relies upon our internal and external structure.

Textiles take shape when they are fitted to the body, furniture, or interiors. We see this through the manipulation of fabric as clothing, upholstery, or curtains. For example, the Bauhaus textile designer Annie Albers differentiated the scale of textiles from the body to clothing as a second skin and referred to textiles for the interior as a third skin.[21]

If we think of a body as an entity wrapped in a skin, the surface of the skin can wrinkle or stretch depending upon the form and movement of the body beneath. As the entity changes, the surface responds.

5.2 **Grain (textile)**

For woven textiles, grain refers to the orientation of the weft and warp threads. The three named grains are straight grain, cross grain, and the bias grain. In sewing, a pattern piece can be cut from fabric in any orientation, and the chosen grain or orientation will affect the way the fabric hangs and stretches and thus the fit of a garment. Generally speaking a piece is said to be cut on a particular grain when the longest part of the pattern or the main seams of the finished piece are aligned with that grain. Non-woven materials such as felt, interfacing or leather do not have a grain.[22]

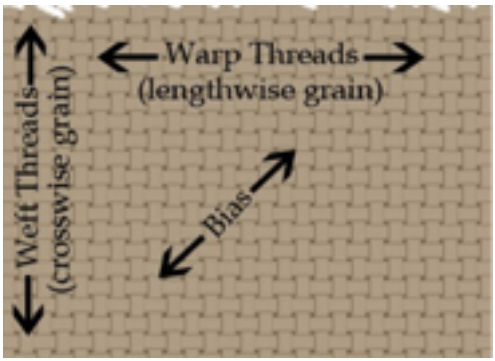


Fig.17

5.3 **Straight Grain**

The straight grain is oriented parallel with the warp threads and the selvedge. The straight grain typically has less stretch than the cross grain since the warp threads will be pulled tighter than the weft during weaving. Most garments are cut with the straight grain oriented top to bottom.[23]

5.4 **Cross Grain**

The cross grain runs perpendicular to the selvedge and parallel to the weft threads. The cross grain generally has more stretch than the straight grain since the weft threads are generally looser than the warp during weaving. Most garments (like pants or shirts) are cut on the straight grain with the cross grain parallel with the floor when the wearer is standing. This allows more stretch through the width of the garment, such as in a pants leg which needs more circumferential than vertical stretch. Garments are sometimes cut on the cross grain, generally because the pieces are too wide to fit on the straight grain. [24]

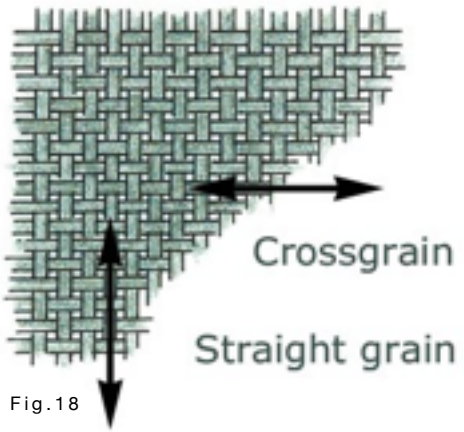
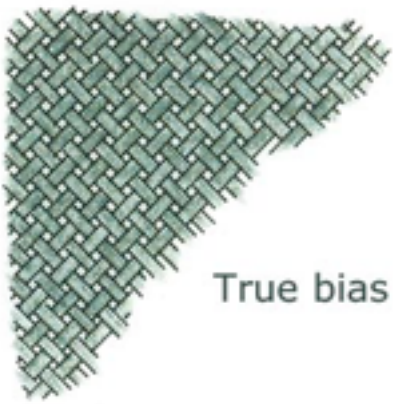


Fig.18



5.5 **Bias Grain**

The bias grain of a piece of woven fabric, usually referred to simply as “the bias”, is at 45 degrees to its warp and weft threads. Every piece of woven fabric has two biases, perpendicular to each other. A garment made of woven fabric is said to be “cut on the bias” when the fabric’s warp and weft threads are at 45 degrees to its major seam lines.

Woven fabric is more elastic as well as more fluid in the bias direction, compared to the straight and cross grains. This property facilitates garments and garment details that require extra elasticity, drapability or flexibility, such as bias-cut skirts and dresses, neckties, piping trims and decorations, bound seams, etc.

The “bias-cut” is a technique used by designers for cutting clothing to utilise the greater stretch in the bias or diagonal direction of the fabric, thereby causing it to accentuate body lines and curves and drape softly.[25]

6. Precedents

6.1 Wrinkles by Noa Zilberman

In this project, Noa Zilberman examines the ageing process of the human face by creating a unique wrinkles map on which her future wrinkles are represented, filled in, and repaired using a gilded metal thread.[26] The resulting "map" led to the design of wrinkle map jewelry for the face and neck in which the contrast between young facial skin and the unavoidable wrinkles awaiting occurs.

This project provides a platform for morphological transformation that addresses skin memory through the timeline associated with the ageing process, along with a gold wrinkles map that follows the facial lines of cleavage. It is an intervention that underlines the function of the objects as jewelry and causes us to question the distinction between repairing and impairing through our concepts of ugliness and beauty.

Fig.19

6.2 **Traces by Fabrice Schaefer**

This project addresses skin memory through the physical representation of traces and marks. Fabrice Schaefer examines the relationship between our skin and any other object in contact with our body. [27] In this case jewelry is the focus of this project, and it illustrates how our skin can has a short memory and traces any surface it has been in contact with. Fabrice Schaefer, a French jewelry designer focused on another important aspect of wearing jewelry. When we wear a ring or a necklace, it presses on our flesh and becomes one with it, and when this jewelry is removed, the skin retains its imprint. Our body, for a moment, becomes a temporary living jewel.

Fig.20

6.3 **Bio Protection**

Protective clothing aims to provide safety and security, which are among the most primal of human needs. Clothing can compensate for the vulnerability of the body, providing practical solutions to the risks to human behavior such as cyclists, who face the threat on the streets every day, or the laborer working on a construction site.

Garments are made to meet human needs, but current protective suits have more in common with the heavy body armor worn by medieval knights rather than items of clothing. The rigid forms of armor moved with the wearer, mimicking the tough exoskeletons of insects, yet the weight of the metal restricted their movement.

Today, a number of designers create protective garments that strive to make surfaces that are resilient like armor but flexible like fabric.[28]

Fig.21

6.4. **BIO-Skin by MIT**

Teams from the MIT Media Lab's Tangible Media Group and Royal College of Art have used bacteria's ability to expand and contract in reaction to moisture, to develop a method for incorporating these qualities into material that can be used for garments.[29]

Clothing created from this biologic fabric has vents that open in response to sweat. As the wearer sweats the material covering the vents peels back. These apertures provide ventilation for the wearer while exercising. The vents fold back into place once humidity levels have lowered.

Fig.22

6.5 Temperature Active Auxetics Meta-Material by MIT

Researchers at MIT Media Lab are now experimenting with making meta-material, a material system that can be applied to several different types of material, that is temperature-responsive, creating a new meta-material that expands and contracts when exposed to different temperatures.[30]

The meta-material is designed to be used as a second skin in fashion design, tightening in cold weather to keep warmth inside and loosening up in hot weather to let air in. The material does not require human action to activate, but instead responds to the weather's condition creating the stimulus interaction. It acts like the pores on our skin and they have implemented the 4D printed textiles that react to changing seasons.

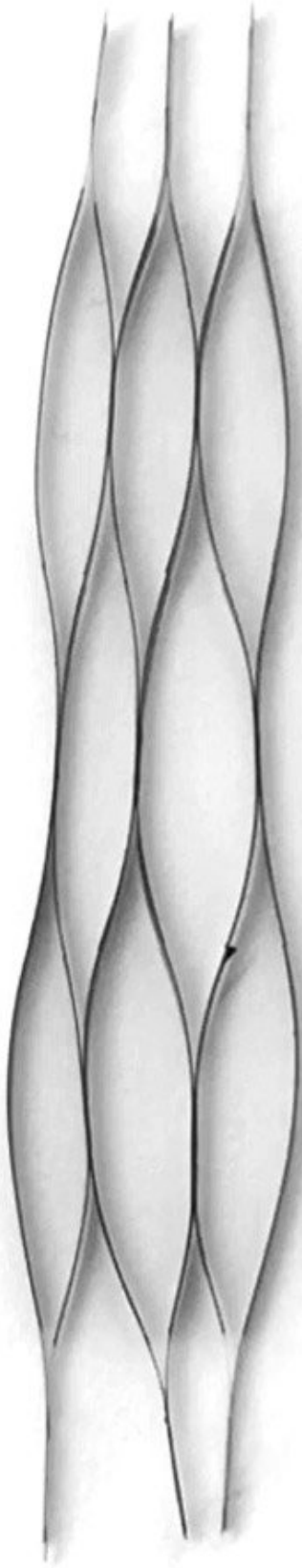


Fig.23

Fig.24

6.6 **A Woman's Work Is Never Done – Flesh/ Thread**

A London-based artist Eliza Bennett, used her own skin as a canvas by stitching thread into the top layer of her skin to create an unusual embroidered artwork as part of a series entitled 'A Woman's Work is Never Done' to give the impression of hard work. She explains: "By using the technique of embroidery, which is traditionally employed to represent femininity and applying it to the expression of its opposite, I hope to challenge the pre-conceived notion that 'women's work' is light and easy. Aiming to represent the effects of hard work arising from employment in low paid 'ancillary' jobs, such as cleaning, caring and catering, all traditionally considered to be 'women's work'." [31]

In this project Bennett highlighted the lines of cleavage on the palm of her hand in a very abstract way that visually illustrates skin manipulation. The project illustrates the physical lines of cleavage on the hand, mixing those threads with the human skin as a protruded tattoo.

6.7 **The Birth of Us by Anders Krisar**

Anders Krisar's sculpture 'The Birth of Us' (2007), examines the divided and chaotic nature of the human condition, creating life-like forms that bear indelible marks. His sculptures are realistic, and yet subvert the human form. Although the material he used resembles human flesh, his work also examines skin manipulation. "I think the body has become more conceptual and less felt in the post digital age. Instead of being in the moment, it seems more important for us to document it, to prove that we were there."[32] His tactile process stands at odds to this disembodied and distracted experience of the self, and yet his final forms show signs of violence, division and the struggle of identity.

The material he used is reminiscent of human flesh. Through the use of silicone, Anders was able to capture physical imprints and preserve a memory or experience that the faux body went through.

Fig.25

7. Explorations

The following experiments investigate various attributes of skin and the material that is used in conjunction with it. These second or parallel skins offer direct contact with our bodies and the threshold of different interaction sand behaviors. Using different materials, such as wood and acrylic, the skin lines of cleavage are used to inform these secondary functions through a series of experiments that address flexibility, protection and memory.

Fig.26

7.1 **Bio-Upholstery**

Fig.27

The objective of this experiment was to explore the aesthetic possibilities of human skin through experimenting with a series of stretchable materials to imitate the skin's flexibility. It highlighted the adaptability of skin, but also its function as our own biological upholstery. The project is a representation of skin manipulation and human body deformation, whilst also illustrating the skin as the largest organ, covering the body, as the medium through which we interact with the world.

Using a stitching technique, I was able to highlight the lines of cleavage on a stretchable fabric. I used balloons to demonstrate the boundaries of skin, determining how far they can be pushed and if the fabric is capable of being stretched even further.

The intent of using this stretchable material and adding the lines of cleavage, was to manipulate the grain direction and material texture to achieve more flexibility where the lines are stitched. The outcome was documented through video in order to capture the fabric's reactions to the balloons as they were inflated and deflated. The outcome unexpectedly did not succeed in achieving more stretchable material where the lines are stitched. Rather, the stitches made the fabric more structured and not as flexible as I expected it to be.

Fig.28

Fig.29

7.2 Experimentations in Kerf Cutting

The inspiration behind this experiment was stretch marks. It shows how our skin is capable of expanding with the different conditions of our body, such as pregnancy and weight gain. These stretch marks were represented in the following experiment using a kerf cutting technique, which gives the material a tendency to stretch as well as the ability to manipulate the grain texture and achieve different properties with the material. The primary objective of this experiment was to examine the potential of the kerf cutting technique in understanding the future potential functionality of the lines of cleavage. This was explored through the use of various materials including wood, acrylic and leather. Material properties were thoroughly tested in order to understand the potential of each material.

"Kerf" is a term that refers to the material removed during cutting. This experiment used laser cutting to reduce the amount of materials being cut. Technically, the more kerf cuts there are, the more bendable and flexible the sheet becomes. As a physical representation of the lines of cleavage on our skin, the more lines in some areas on our skin, the more flexible and stretchable it is.

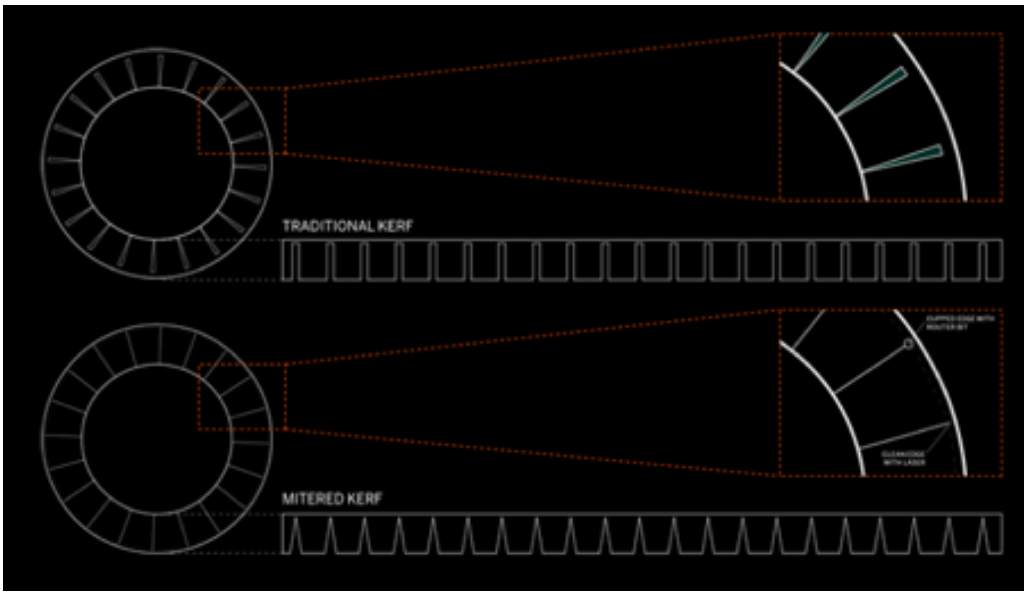


Fig.30

In this experiment, I used the kerf cut technique as a physical representation of the lines of cleavage that are apparent in stretch marks. An increase in the amount of stretch marks indicates that the skin has been through a physical change such as bodily weight gain.

In this experiment, I tested different materials such as wood, acrylic and leather to get a better understanding for the kerf cutting technique. I used the laser cutter to create the kerfs required to bend the material. However, using the laser cutter restricted the materials thickness from 1mm to 4mm.

The laser cuts away a portion of the material, depending on the type of the material and its thickness. If the material thickness is less than 2mm the average distance between the cuts should be bigger than 0.5mm, otherwise the cuts will burn the material away or it will warp whilst cutting.

Therefore, the minimum cut cannot be smaller than the thickness of the material. For example, if cutting 3mm acrylic, it's best not to allow any distance less than 3mm. If the distance is smaller, it can make the pieces very fragile, which might not be suitable for any application.

Cutting across the grain of the material is the most effective way to minimize breakage. This allows the fibres of the material to hold the whole piece together. When I tried cuts parallel to the grain, the material tended to fall apart and break. However, this is opposite to the idea of scaring our skin across the lines of cleavage. When the skin scars it will leave a mark, but if the cut is parallel to the lines the skin will not scar and it will heal faster.

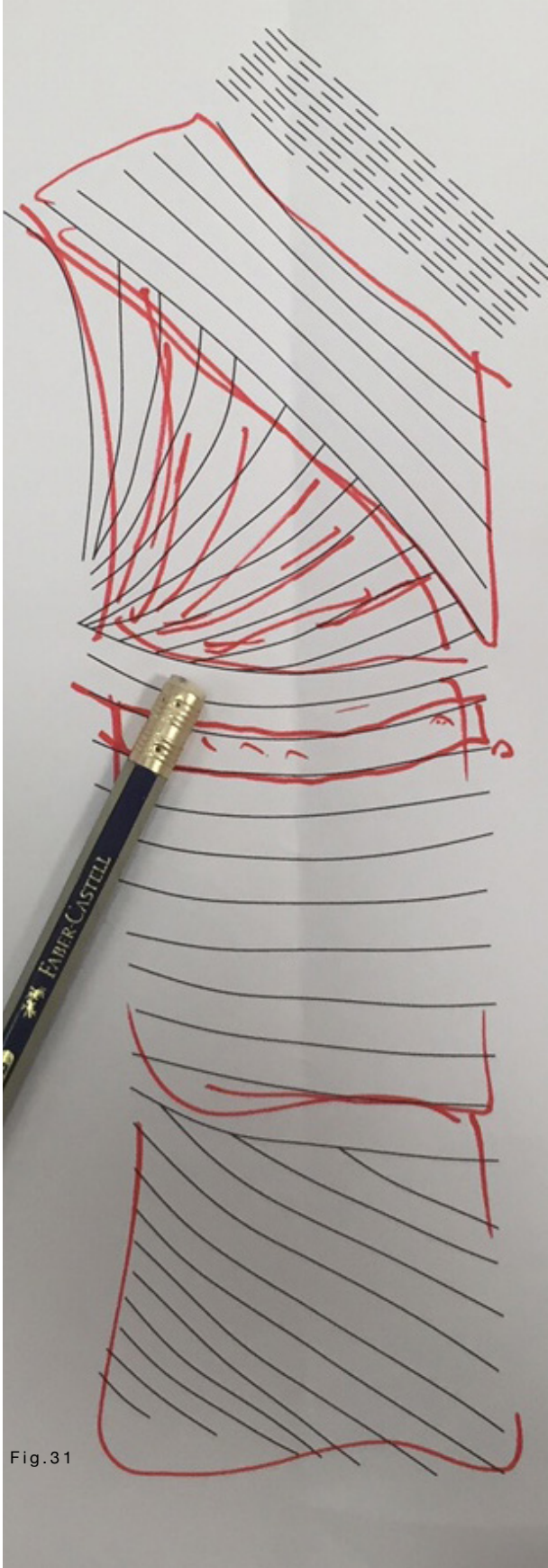


Fig.31

7.2.1 **Kerf 1**

In this first kerf experiment I began with a 2D spring, one of the simplest patterns, which turned out to be more flexible than expected. It was an attempt to bend in two directions, which it does not. However, it bends in one direction very well and it works especially well with the thinner materials such as leather, which worked well as a vertical spring.

Fig.32

7.2.2 **Kerf 2**

The intention of working with this pattern was to distribute the stress of the tension evenly. Sharp corners tend to be breaking points when a material is under stress. Rounding the corners distributes that stress a little more evenly along the cuts.

This experiment gave me the maximum stretch and the amount of material removed was almost 50% of the total material. The cuts were only in one direction perpendicular to the grain of the material. Therefore, I was not able to bend the material in two directions. Since it only bent in one direction, it leads to experimenting with the following pattern.

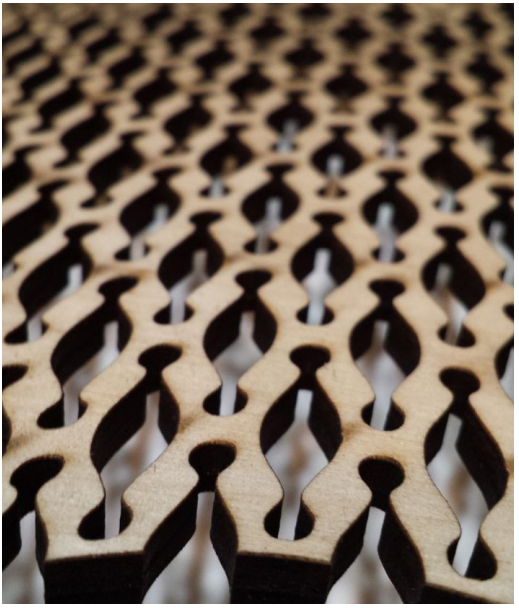


Fig.33

7.2.3 **Kerf 3**

This pattern was inspired by the finger print pattern on our skin. The circular pattern distributes the stress a little more evenly along the spring and connect the patterns made it like a loop.

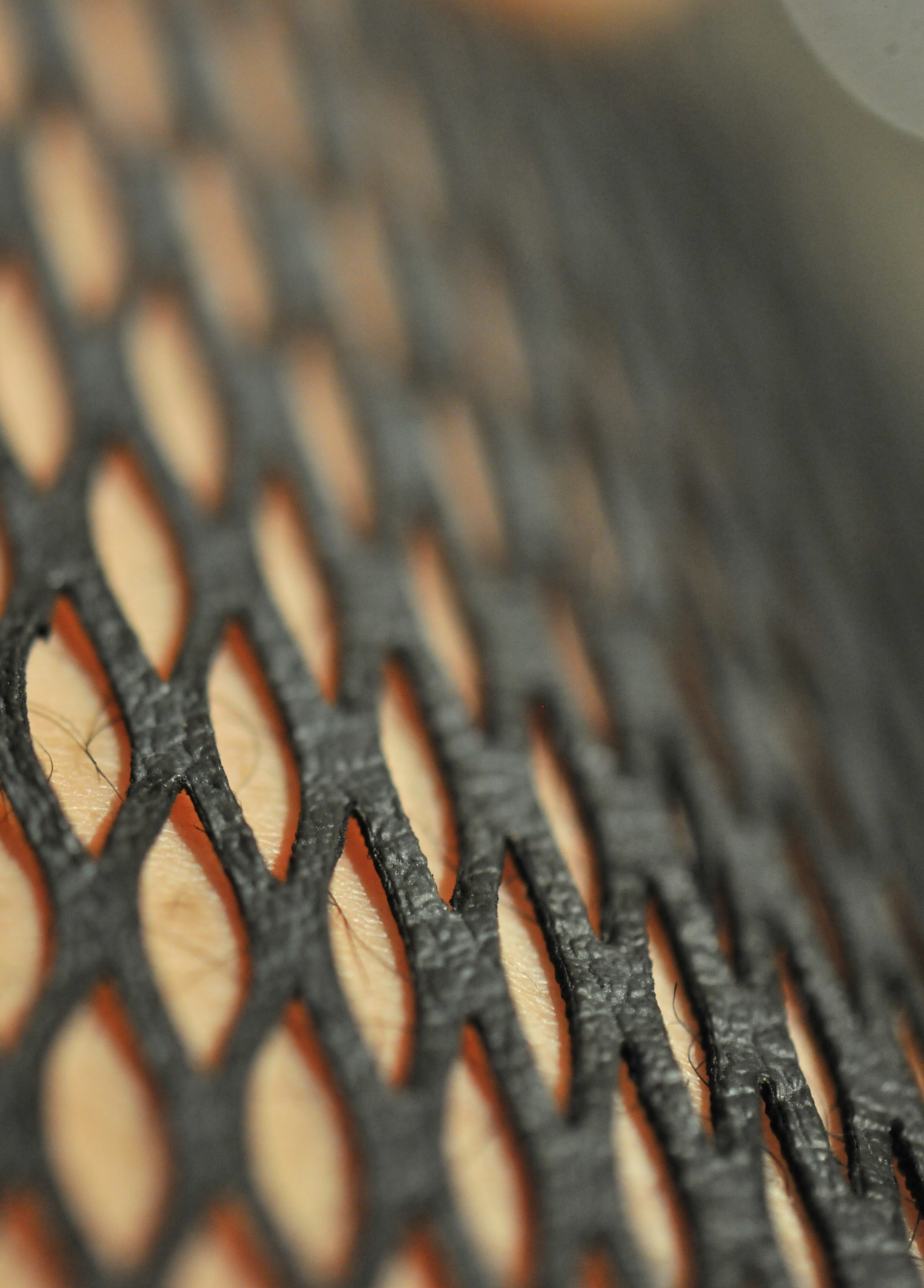
The main purposes of the finger print ridges are to give the fingers a firmer grasp, to avoid slippage and be able to pick up an object. However, these ridges are unique from one person to another, so much so that they can be used to identify individuals. These ridges are located on both our hands, feet. They cannot be altered; even when the skin tissue is injured, they regenerate.

Due to the loop/spring effect in the pattern, it was the most successful experiment in terms of bending the material in all directions with minimum cuts or material removal.

Fig.34

Fig.35

Fig.36



Based on these experiments in kerf cutting, the outcome and conclusion from these series of experiments, I was able to create a garment out of one sheet of wood illustrating a second skin.

Fig.37

7.2.4 **Kerf 4**

In this experiment, I worked with the kerf cutting further using scale with acrylic, wood and leather. The outcome was unexpectedly flexible and bendable in all directions in both acrylic and wood. The scale factor in this experiment made it a major change due to the cuts being very close to each other. It worked well with wood and acrylic. However, with leather, it started to fall apart because of the thickness of the material was too thin compared to the density of cuts; the outcome was not structured and it started losing its sheet form.

Fig.38

Fig.39

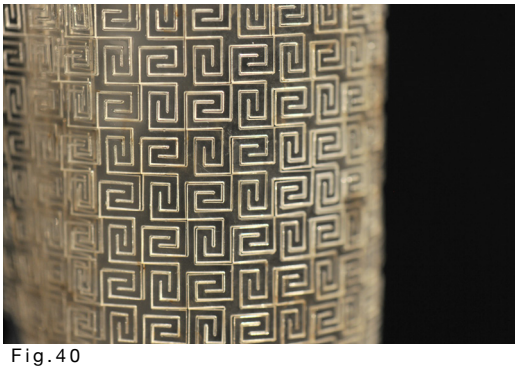


Fig.40

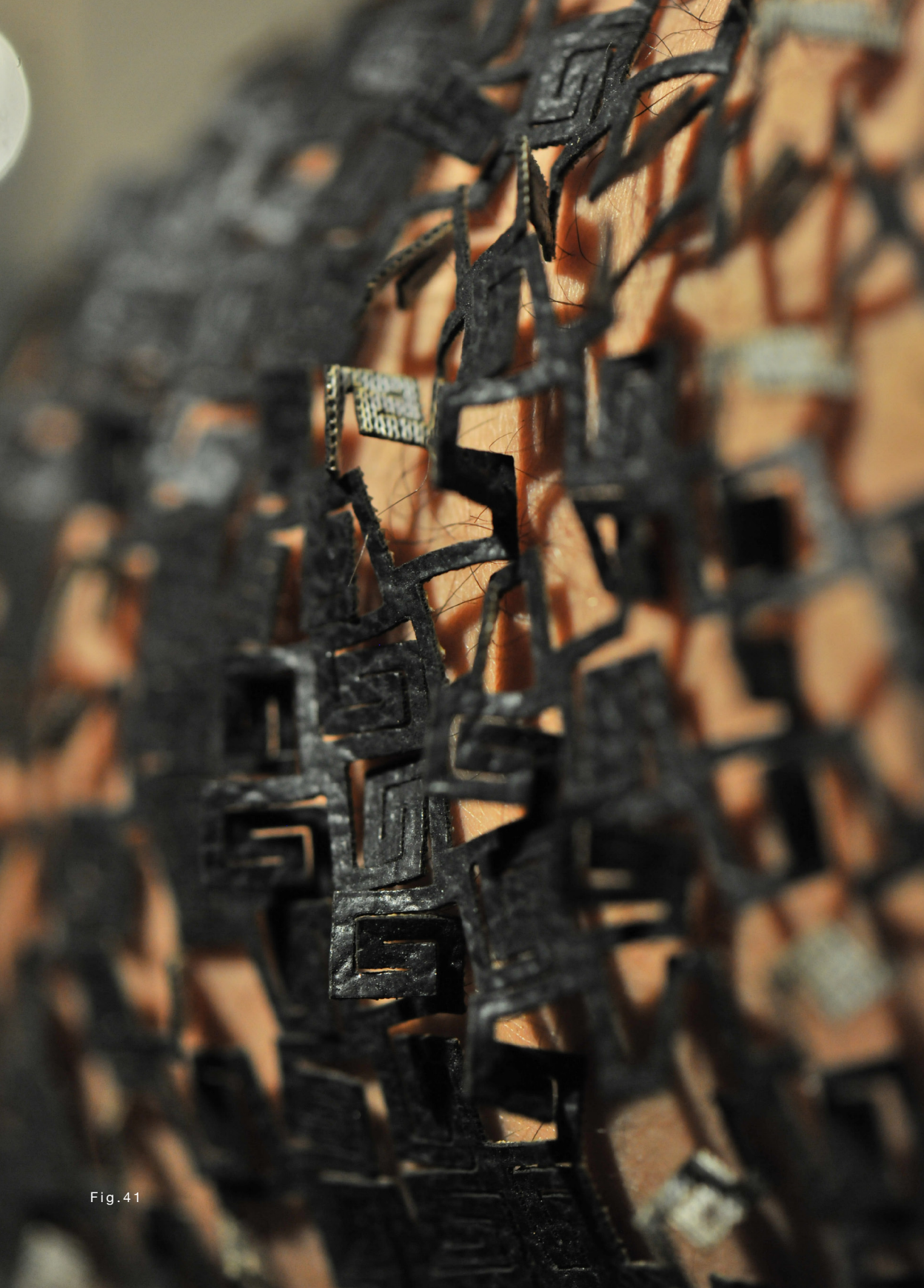


Fig.41

7.3 **Experimentations with Weaving**

After proceeding with the kerf cuts using leather against the grain direction, the outcome was dictated by the thickness of the material and the cut density. This led to the failure of some experiments where the cuts are smaller than the material thickness.

Braided fabrics are used in textile composites. Textile composites are produced by impregnating materials into their dry forms to hold the multi directional yarns together. This led to the weaving technique inspired by the bias direction and compared to the cross grain direction.

7.3.1 **Weaving Leather**

In this experiment, I wove leather through the use of the laser cutter. By doing so, I created an alternate grain in the material that led to a stronger material for textiles application.

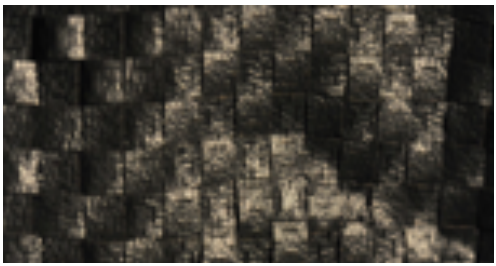


Fig.42

7.3.2 **Weaving Silicone**

In this experiment, I created a skin like material engraved with the lines of cleavage. This was done through the use of a mold created with a CNC router, foam, and silicone. The experiment was successful is imitating skin. However, it was unsuccessful in its application in weaving due to its viscous properties.

Fig.43

7.3.3 **Weaving Foam**

In this experiment, I wove polyethylene foam, in an effort to imitate the microscopic outer epidermal layer of skin. This material was specifically chosen due to its spongy properties. Additionally, it was more effectively woven than the previous material and resulted in a structured, tight weave.

Fig.44

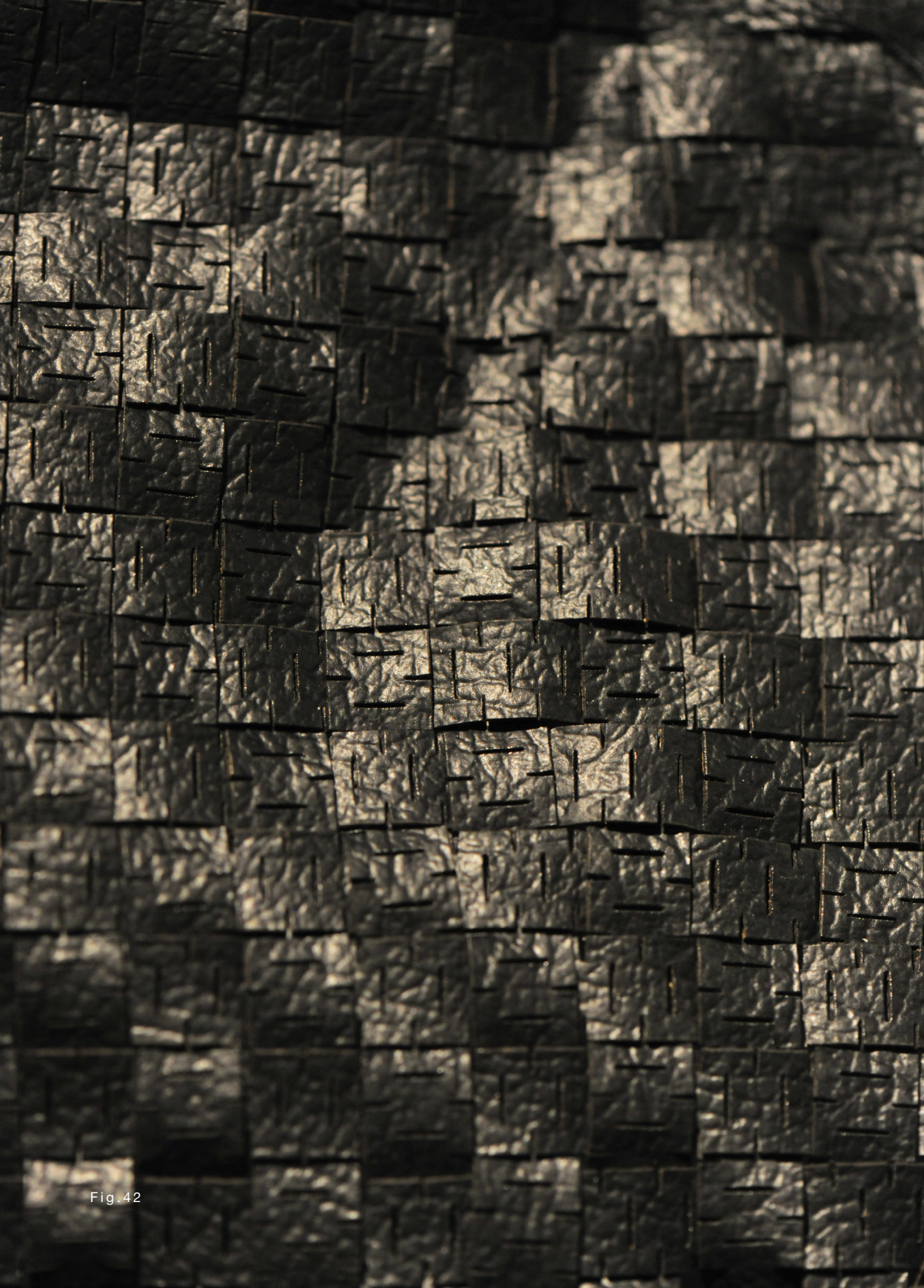


Fig.42

7.4 **Second Skin**

Our skin is regarded as the protector of both our physical and emotional self. As the interface of haptic communication, it is the largest organ we have that gets to touch and be touched by both our environment and our internal biology. It is a critical element of our sensory system "the mother of all senses" that allows us to interact with other people, objects, and space.

Second skin is based on research regarding skin structure and its main function of protection. Skin is a shelter, a layer that concurrently protects and absorbs. It is always responding to our body's internal and external conditions. In this manner, this project is about protection, helping us experience and understand the space around us, leading us to form a portion of our identity. The wrinkles, moles, scars, tints, hairs and stretch marks that our skin holds forms a unique topographic identity, affected by what our skin encounters with the environment.

Fig.45

7.5 **Skin Memory**

Fig.46

The somatic sensitive areas of our brain construct the dynamic maps that help our bodies configure the environment through the haptic senses. We would not be able to localize our interactions with the environment, nor would we be able to use the sense acquired (or required) when touching an object.

Events can leave behind marks, bruises, stains, footprints and memory. This project is a collective of residues that remain after events fade. The margin between the seen and the unseen are represented in marks and residues. What is the intersection between the past and the present? What lies at the intersection of the psychological and physical memory?

'Skin Memory' explores function and perception through an examination of surfaces, acting as skin, boundaries, imprints and residues that offer information used to clarify distorted and unseen concepts. Additionally, it explores how to translate a psychological memory into a tactical memory. In doing so, it surveys what our bodies get into contact with during daily activities. The intent was to create a structure that would help capture and document the location and environment of an individual's interactions - where have they been touched. The traces are visible and tactile. The process is more reflective, as the body is a reflection of our behaviours, and the impact of our interactions with the environment and others, which results in residues left on our body.

8. Outcomes

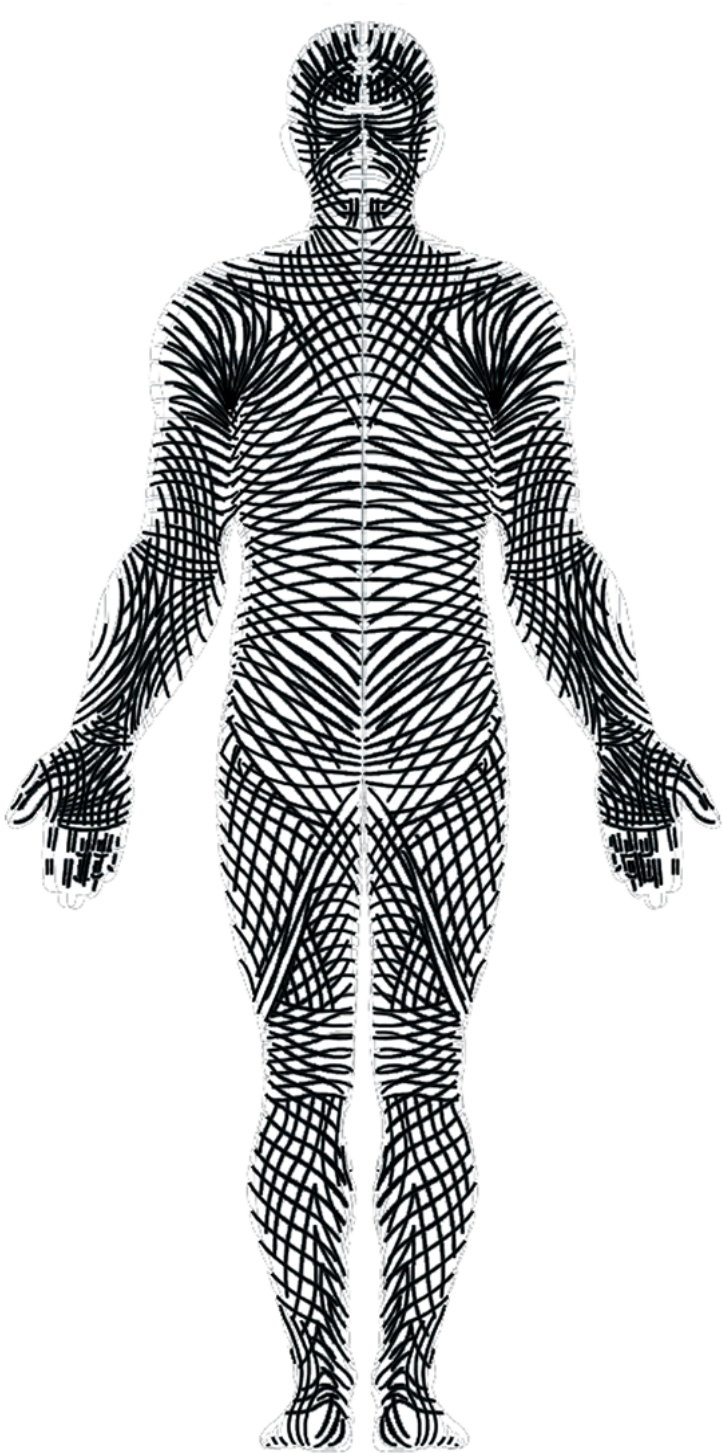


Fig.47

The following outcomes are a culmination of secondary research and experimentations in form and material. The intent of these fabricated forms is to demonstrate the realization and proposed interpretation regarding the skin's memory, protection, and flexibility. The outcomes consist of three male figures covered with three different materials; plaster, foam, and leather.

Fig.48

Fig.49

Fig.50

8.1 **Man.0**

Man.0 is a 3D figure printed in ABS. The intent of this figure is to provide a map of the lines of cleavage on our skin.

8.2 **Man.1**

Man.1 is a fabricated figure illustrating the lines of cleavage as a physical map extruded on the figure. The intent is to examine the density of lines against various parts of the body. This figure displays the lines of cleavage on our body and the resulting patterns from their intersection. The patterns are comprised of the lines of cleavage from the front and back of the body layered onto one another.

The figure was created using a 3D modelling software, and sliced into vertical pieces to fit onto the CNC machine. I added the intersected lines of cleavage on the 3D model so they could be milled and integrated on the figure.

The aim of this project was to illustrate the possible manipulation that can be applied to the skin using the lines of cleavage. The pattern was created by mirroring and rotating the front lines and the back ones overlaid on top of each other in order to achieve a structured lines of cleavage weaved on the figure.

Fig.51

Man. 1

A figure made from CNC milled layers of foam with the manipulated intersected lines of cleavage.

Fig.52

8.3 **Man.2**

Man.2 is a fabricated figure examining the concepts of protection and memory of the skin. It aims to address how we can protect our skin from elements such as aging for example, and how to preserve its memory.

The process continues with the concept of biological upholstery. Foam is used due its elastic properties. The weaving technique was applied using the flexible foam, resulting in a rigid and structured outcome. This figure, contrasts the previous fabrication outcome in terms of flexibility, for when the material is woven it loses or limits its flexibility as a skin.

Fig.53

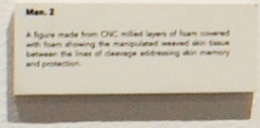
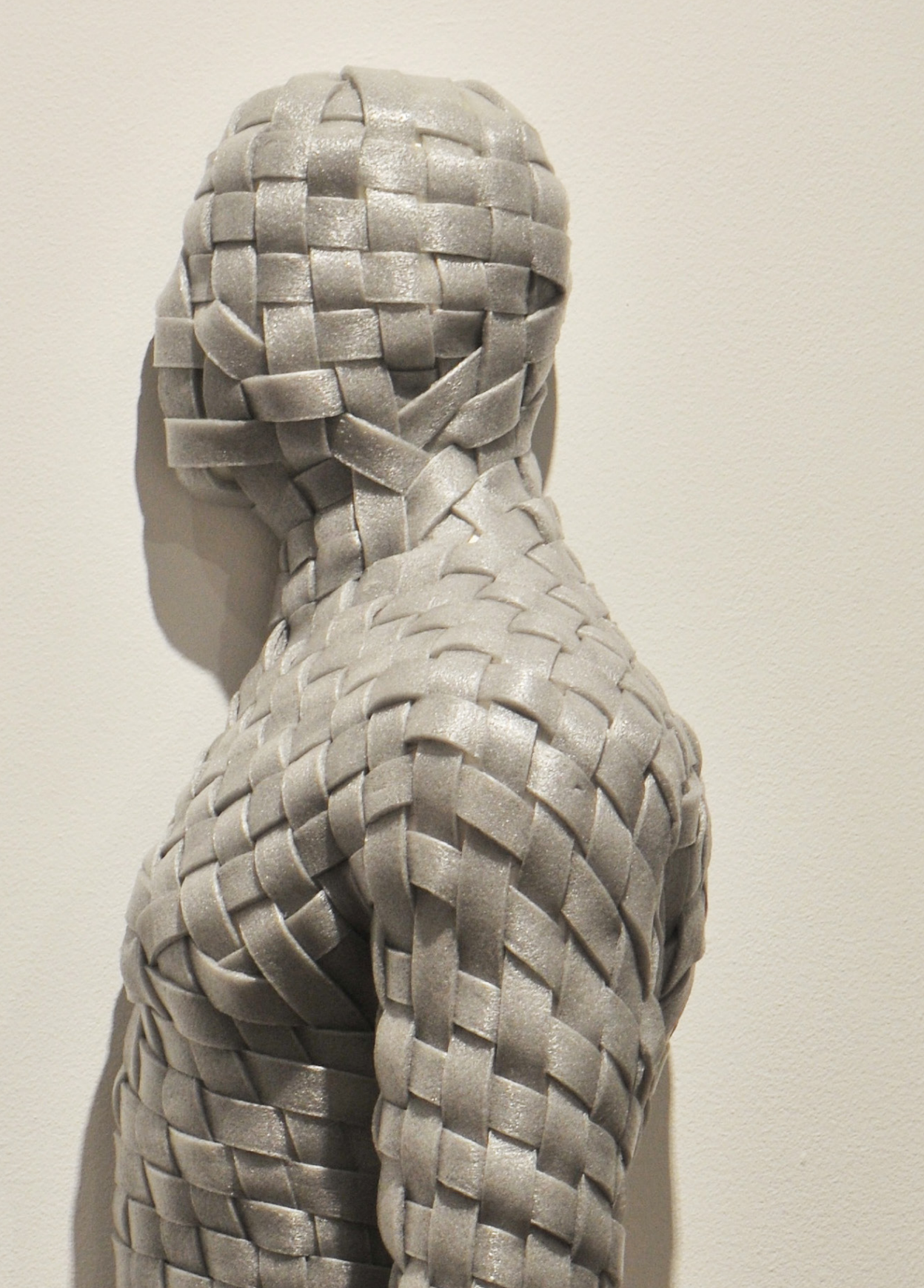

Man. 2
A figure made from CNC milled layers of foam covered with foam showing the manipulated weaved skin tissue between the lines of cleavage addressing skin memory and protection

Fig.54



8.4 **Man.3**

Man.3 is fabricated to illustrate of the physical attributes of stretch found in human skin. Following the skin's lines of cleavage of as a reference, I applied the kerf cutting technique using leather. The material was chosen for its similarity to human skin, as it is technically animal skin and thus behaves in similar ways.

The kerf cuts were juxtaposed with the lines of cleavage obtained from the first figure. The leather became increasingly flexible and stretchable in dense areas of the lines of cleavage. In areas of minimal cuts, the stretch was very minimal. The resulting outcome is a leather suit imitating human skin with the lines of cleavage highlighted within its construction and behaviour.

Fig.55

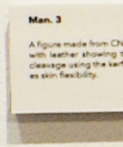


Fig.56

8.5 **Parametric Stretch**

Parametric stretch serves as a demonstration of previous experimentations with kerfing. A select number of material samples were mounted on wooden frames in order to demonstrate the differing flexibility of the material based on its thickness, as well as the number and density of cuts.

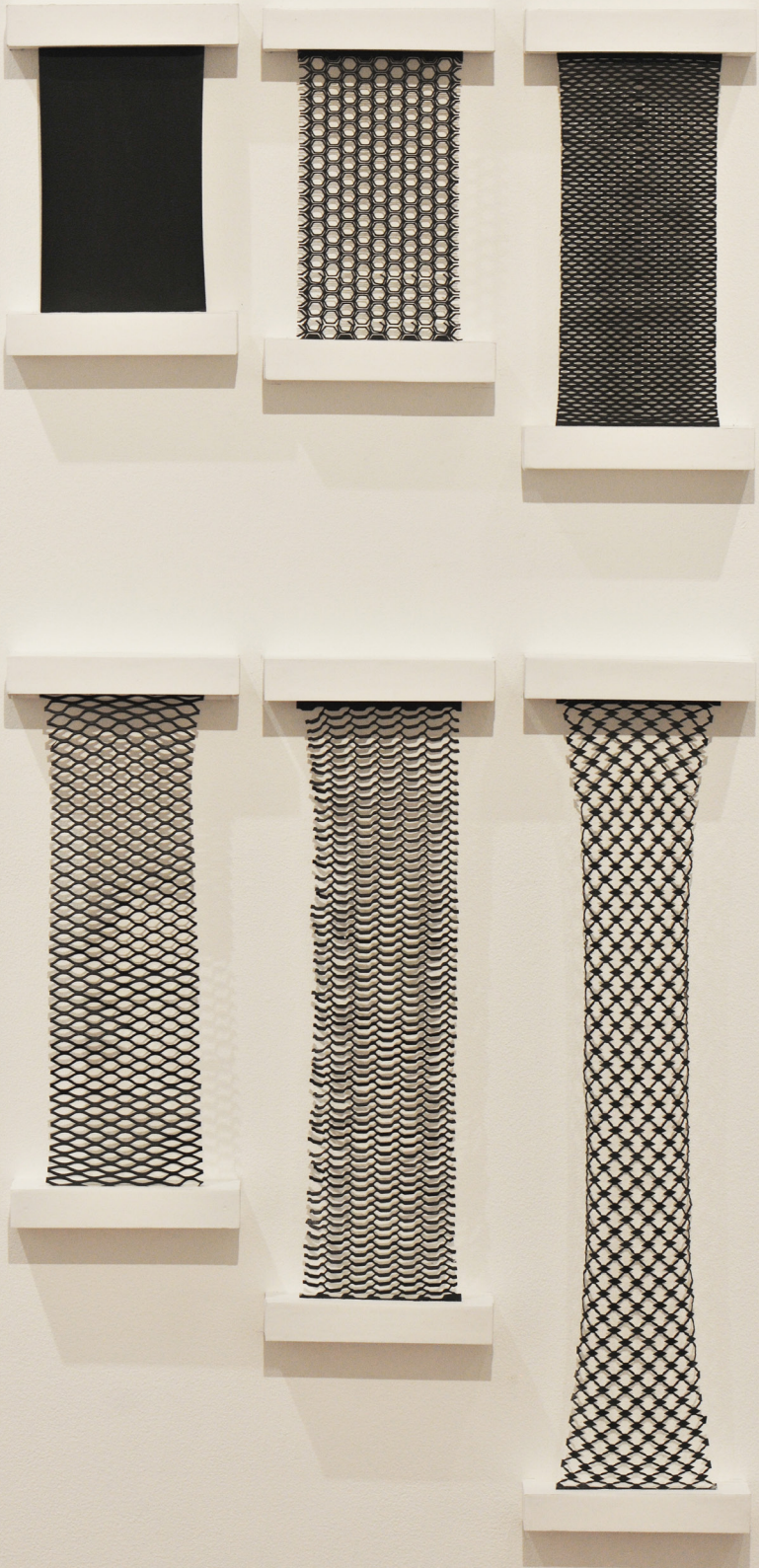
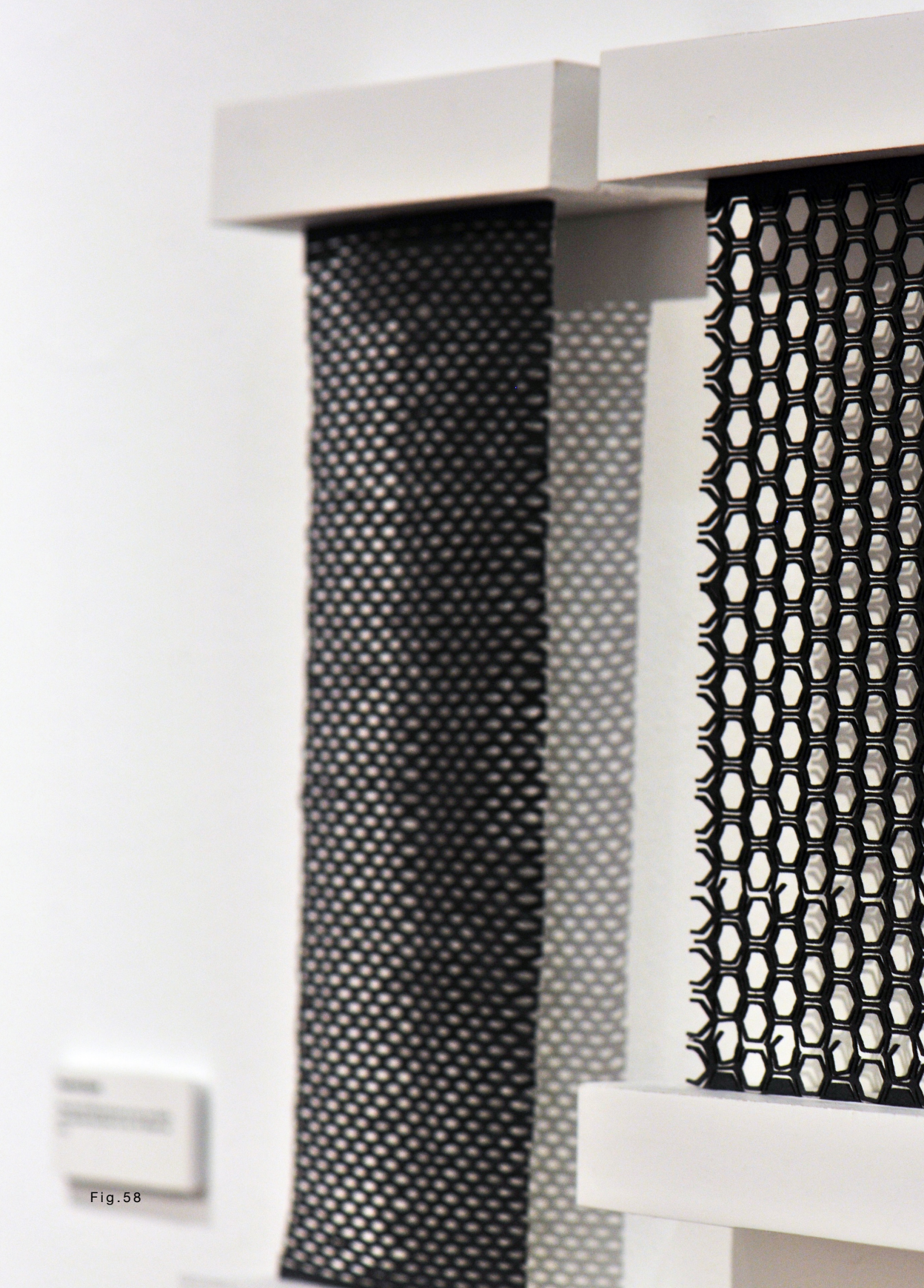


Fig.57



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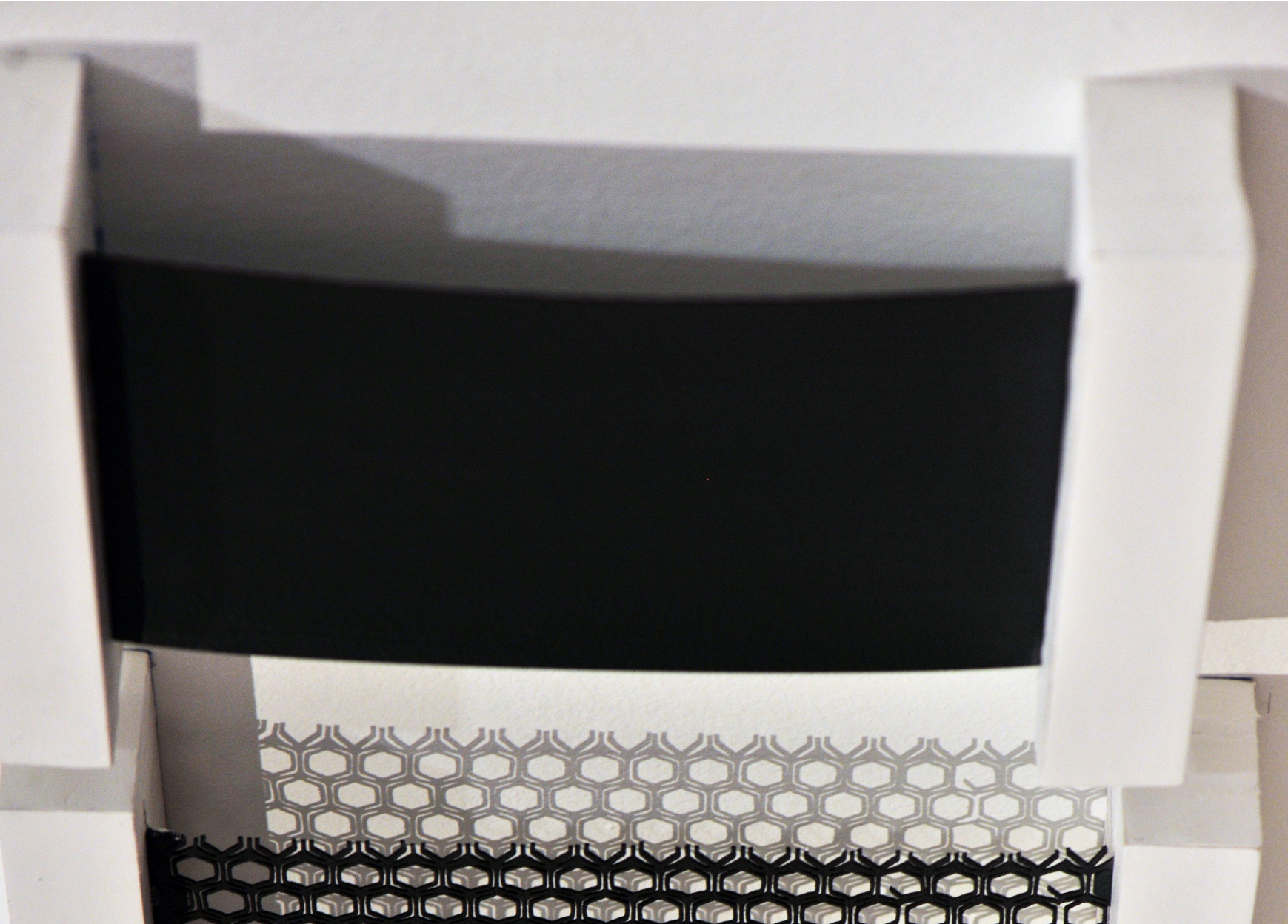

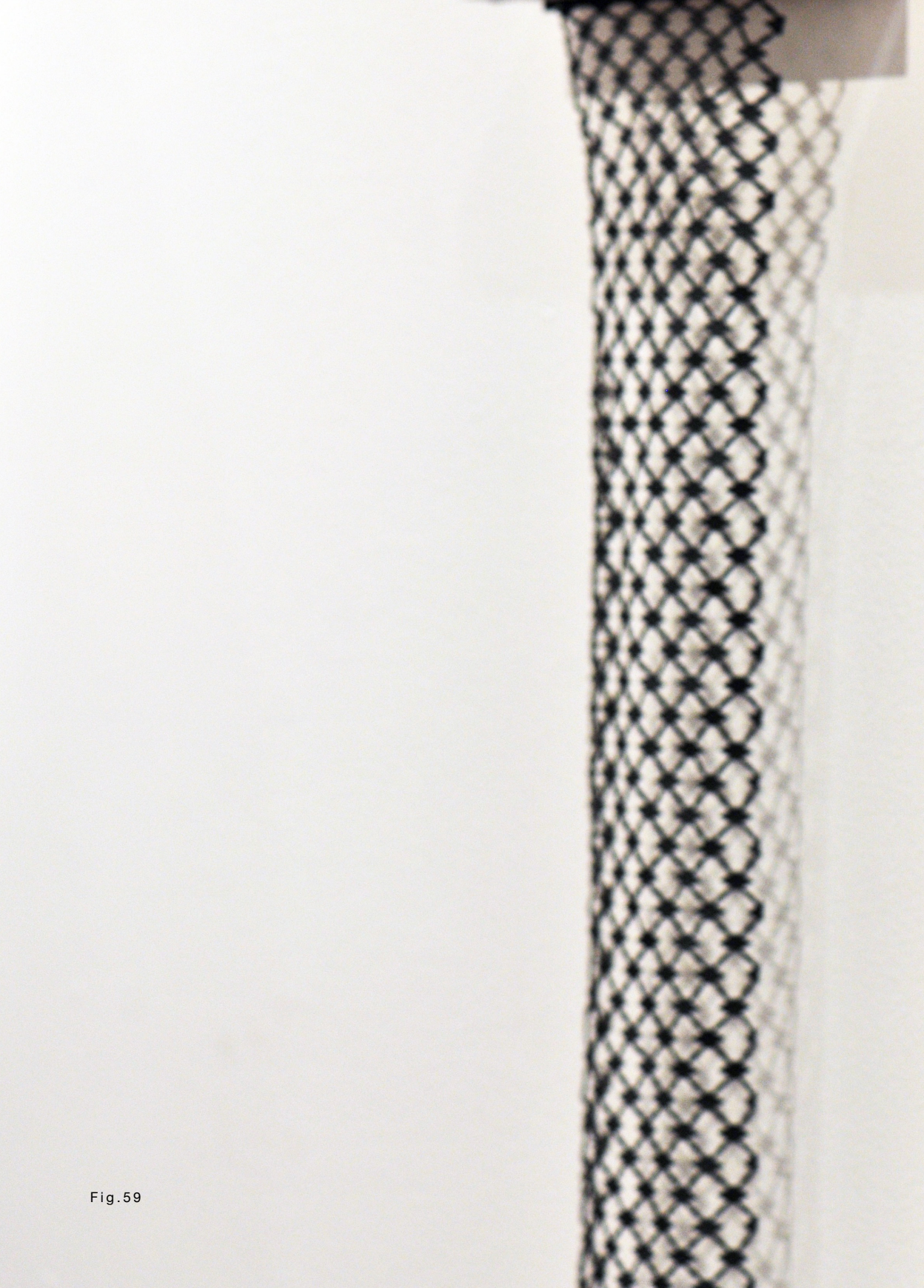

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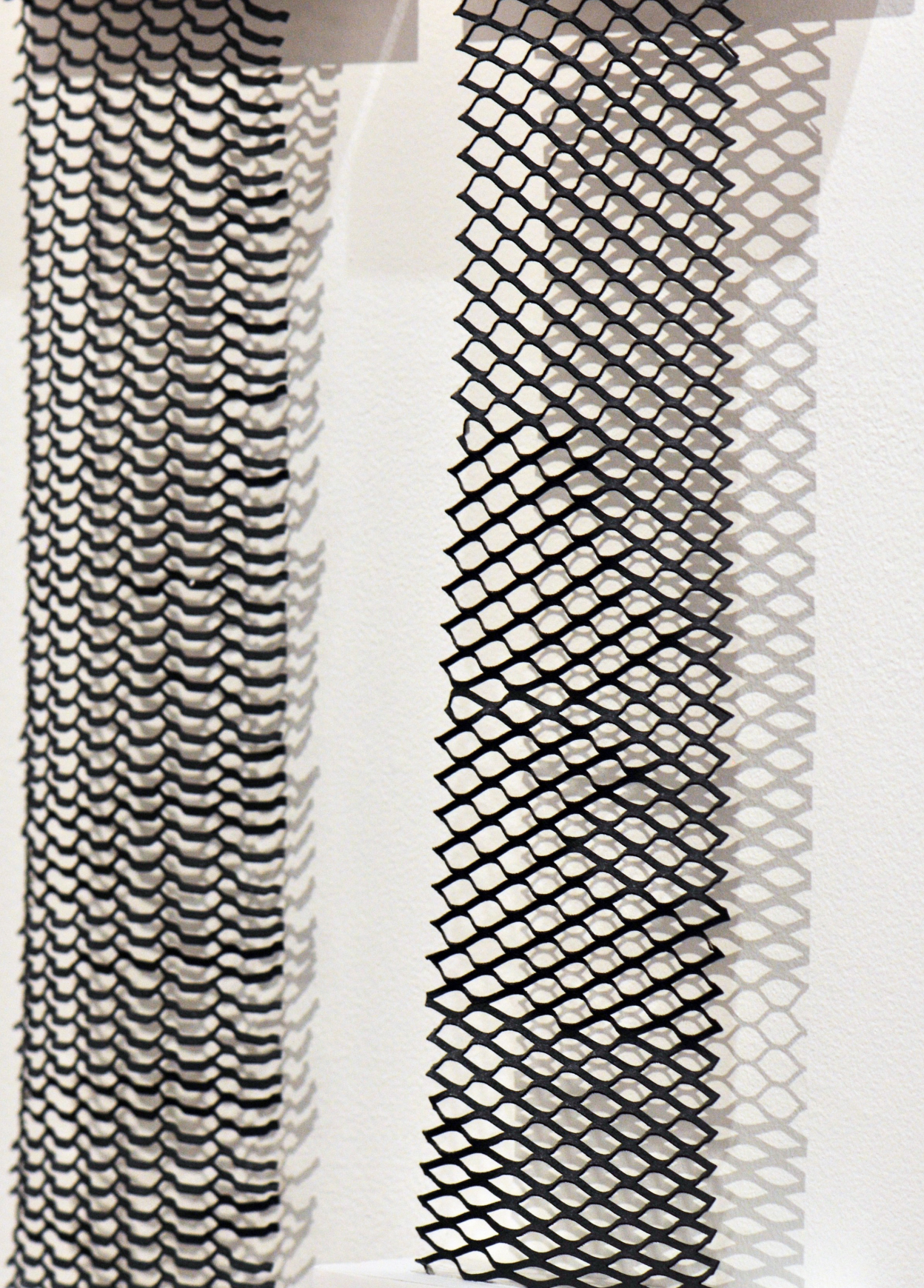

9. Conclusion

This thesis intended to examine the use of materials as a second skin through a series of experiments using kerf and weaving techniques to imitate the different functions of human skin and to achieve a better function of these materials to address skin flexibility, protection and memory. The focus was to examine the potential of utilizing different materials as a second skin responsive to our skin. Through the process of manipulating the lines of cleavage in these materials, the different cuts and weaves were combined to achieve and inform an alternate second skin.

Throughout the experimentations with the kerf cutting, the scale factor or distance between the cuts made a significant difference. Closer cuts led to increased flexibility. This technique worked well on the wood and acrylic. However, with leather, it started failing because of the relative thinness of the material, and the leather started losing its sheet form. The most successful experiment from the kerf cutting was the spiral loop pattern using wood and acrylic. However, with leather, the straight cut was the most successful in addressing flexibility, due to the material's relative thinness.

In the weaving experimentations, I wove polyethylene foam in an effort to imitate the microscopic outer epidermal layer of skin. This material was specifically chosen due to its spongy and compressive properties. Additionally, it was more effectively woven than the silicone material and resulted in a structured, tight weave.

9.1 **Further Research**

Second skin has been experimented with through different materials according to the user's behaviour. A second skin, informed by the lines of cleavage, may achieve increased functionality for our skin as a threshold. However, as indicated by the experiments conducted, these materials are directly associated with only two dimensions; the form of the material transforming from a sheet form to be wrapped on the human body. In order to produce a more functional second skin, the materials experimented with needed to be physically altered to allow them to wrap around the body.

Further research could be conducted, through the use of 3D scanning, to produce a material custom fit to an individual's specific lines of cleavage. Additionally, further research could consider emerging technologies addressing time as a factor in skin memory, such as how to utilize the 3D scanning technology to produce customized materials for each individual's lines of cleavage's scan.

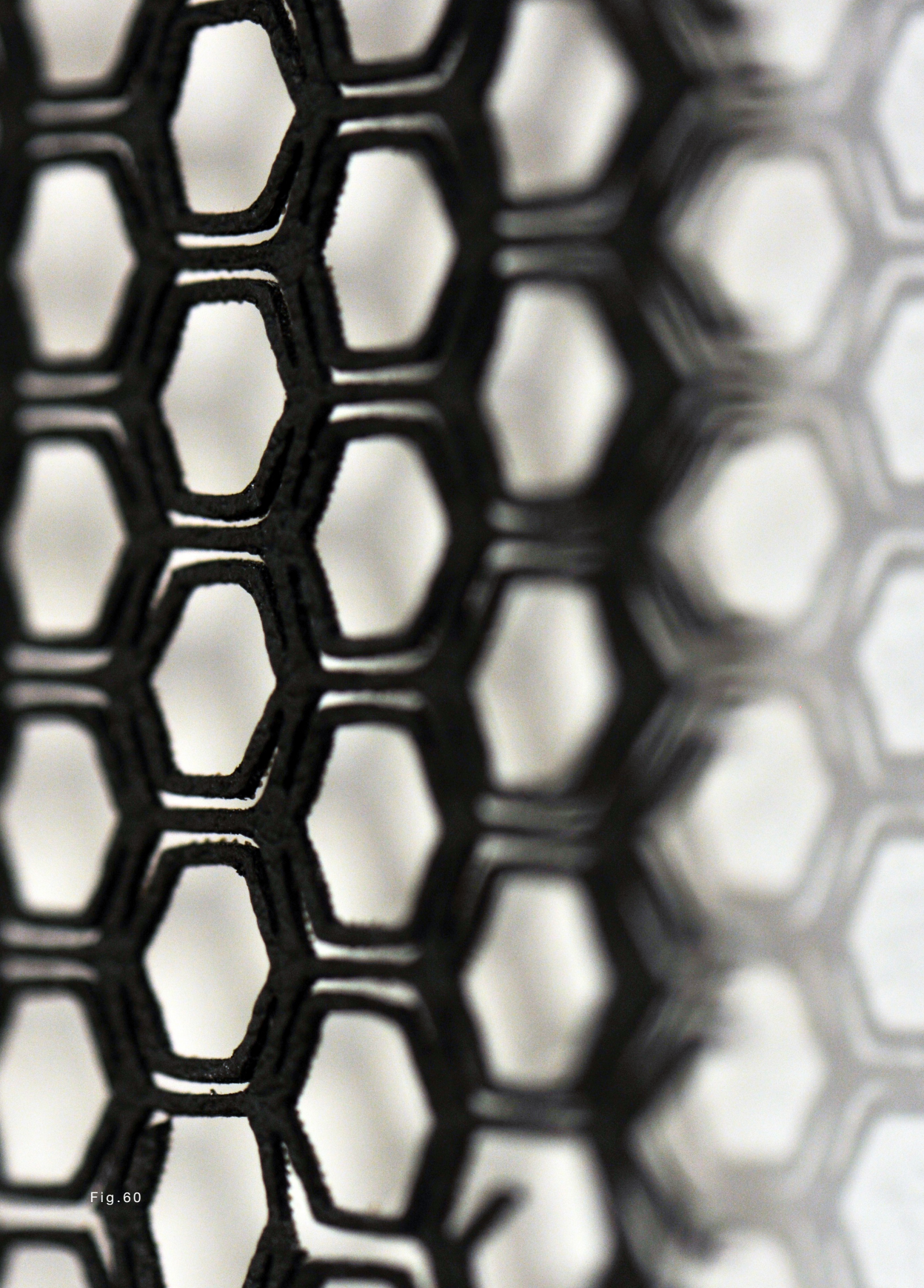

Fig.60


Islam Shehab
SKINFACE
Skin, as the body's largest organ, is the de facto interface between ourselves and our environment. Throughout history humans have used various techniques to explore the limits of skin. This thesis investigates skin manipulation with the intent of focusing on, and experimenting with, lines of cleavage, and the theoretical fault zones of skin that are used to define the areas of least flexibility. In examining the potential for these lines of cleavage, this thesis aims to explore their manipulation as a means to produce better functionality through a series of projects that address skin flexibility, protection and memory.
PRIMARY ADVISOR
Lee Akulbrook
SECONDARY ADVISOR
Diane Dein
SECONDARY ADVISOR
Richard Blackwell
READER
Mike Watts

Fig.61

Fig.62

9.2 **Future Research**

The research and exploration of the skin and its function in this thesis were synthesized in conceptual designs which sought to demonstrate potential approaches to human body augmentation and skin manipulation, based on the lines of cleavage.

Technological advancements in the field of biotechnology are facilitating improved functionality for the human body. As a future direction of this research, I intend to look at how we can utilize advancements in 3D printing for printing actual human skin to be used in skin grafting. Those explorations will be informed by these conceptual designs using textile grain and the lines of cleavage in order to achieve better and alternative functions for the skin.

Fig.63

Fig.64

10. Endnotes

1 Jacqueline Finch, "The Ancient Origins of Prosthetic Medicine," *The Lancet* 377, no. 9765 (2011): 548–49.

2 "VIKTORIA MODESTA," accessed November 24, 2017, http://www.viktoriamodesta.com/.

3 Kim Hewitt, *Mutilating The Body: Identity In Blood And Ink* (Bowling Green, OH: University of Wisconsin Press, 1997).

4 "The Vampire Woman of Mexico," *Laughing Squid* (blog), October 31, 2013, https://laughingsquid.com/the-vampire-woman-of-mexico/.

5 Tony Burns and Graham Arthur Rook, eds., *Rook's Textbook of Dermatology: In Four Volumes*, 8th ed (Oxford: Wiley-Blackwell, 2010).

6 Burns and Rook.

7 H. T. Cox, "The Cleavage Lines of the Skin," *British Journal of Surgery* 29, no. 114 (1941): 234–40.

8 Cox.

9 Burns and Rook, *Rook's Textbook of Dermatology*.

10 Burns and Rook.

11 P. Itin and G. B. E. Jemec, *Textiles and the Skin*, ed. P. Elsner, K. Hatch, and W. Wigger-Alberti, 1 edition (Basel ; New York: S. Karger, 2003).

12 Burns and Rook, *Rook's Textbook of Dermatology*.

13 Rosemary L. Nixon, Christen M. Mowad, and James G. Marks, "Allergic Contact Dermatitis," in *Dermatology*, 4th ed. (Philadelphia, PA, 2018), 242–61, https://www-clinicalkey-com.proxy.library.vcu.edu/#!/content/book/3-s2.0-B9780702062759000143.

14 Nixon, Mowad, and Marks.

15 Nixon, Mowad, and Marks.

16 Nixon, Mowad, and Marks.

17 Nixon, Mowad, and Marks.

18 Nixon, Mowad, and Marks.

19 Cox, "The Cleavage Lines of the Skin."

20 *Skin: A Natural History* – May 21, 2008, 1 edition (university of california press, 2008).

21 Itin and Jemec, *Textiles and the Skin*.

22 "Textile -- Britannica Academic," accessed November 25, 2017, http://academic.eb.com.proxy.library.vcu.edu/levels/collegiate/article/textile/108603.

23 "Textile -- Britannica Academic."

24 "Textile -- Britannica Academic."

25 "Textile -- Britannica Academic."

26 Ursula Ilse-Neuman, *Multiple Exposures: Jewelry and Photography* (New York: Officina Libraria, 2014).

27 Ilse-Neuman.

28 Bradley Quinn, *Fashion Futures* (London ; New York: Merrell Publishers, 2012).

29 "BioLogic Self-Transforming Biological Skin," accessed November 25, 2017, https://competition.adesignaward.com/design.php?ID=46050.

30 Beckett Mufson, "[Exclusive] MIT's New Magic Material Acts Like the Pores on Your Skin," Creators, February 8, 2017, https://creators.vice.com/en_us/article/xy5eak/mits-new-magic-material-acts-like-the-pores-on-your-skin.

31 "*A Woman's Work Is Never Done Text — ELIZA BENNETT*," accessed November 25, 2017, http://www.elizabennett.co.uk/a-womans-work-is-never-done-text/.

32 "Anders Krisár," accessed November 25, 2017, http://anderskrisar.com/.

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